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BOTANY.

The Number of Plants.*—It is a question of science, and, if one will, also of reasonable curiosity, to ascertain approximately at least, how many are the plants which live upon the surface of our globe. And, in fact, almost every work of general botany devotes some attention to this subject. It is indeed true that the criterion of "species" is not equal for all botanists, some having a tendency to reduce, others to multiply (on the ground of very minute differences) the number in existence. The middle criterion of Linnæus, however, prevails by great length, which, somewhat improved, predominates in the classical works of De Candolle, Bentham, Hooker, Grenier, Godron, Koch, Asa Gray, Parlatores, Caruel, etc., etc. Admitted, however, some discrepancy in this criterion, the effect would be almost insignificant in comparison with the immense number of plants. Without enlarging too much upon the successive increases which the researches of the diligent have brought to the number of plants, I will sum up these results in a chronological table:

500–400 B. C.	Hippocrates reckons	234 plants.
310–225 B. C.	Theophrastus "	500 "
77 A. D.	Dioscorides "	600 "
23–79.	Pliny "	800 "
1650.	Caspar Bauhin "	5,266 "
1704.	Ray "	18,655 "

between species and varieties.

1771. Linnæus (see. Richter Cod. Linn.) reckons 8,551 species, of which 7728 are Phanerogams and 823 Cryptogams.

1807. Persoon (Syn. Plant.) reckons 20,000 species of Phanerogams.

1819. P. De Candolle (Theor. El.) reckons 30,000 species of Phanerogams.

1824. Steudel (Nom. Bot. I Ed.) reckons 70,000 species of Phanerogams and Cryptogams.

1841. Steudel (Nom. Bot. II Ed.) reckons 78,000 species of Phanerogams.

1845. Lindley (Veg. Kingd.) reckons 79,837 species of Phanerogams.

1885. Duchartre (Elem. Bot.) reckons 125,000 species, of which 100,000 are Phanerogams and 25,000 are Cryptogams.

* By P. A. Saccardo, translated by Roscoe Pound.

If we wish however to distribute the number of plants according to the principal groups and on the basis of the most recent monographic works, we arrive at the following result:

NO. SPEC.

Dicotyledons	78,200	{ See Durand Index Gen. Phan. 1888. where the numbers are taken from Bentham and Hooker Gen. Plant. 1862-1883.
Gymnosperms	2,600	
Monocotyledons	19,600	
Ferns	2,685	See Hook. and Bak. Syn. Filic. 1868-74.
Equis. Marsil. Lycopod.	565	See Baker Fern Allies 1887.
Mosses	2,303	See Mueller Syn. Musc. 1849-51.
Liverworts	1,641	See Gott. Lind. Nees, Syn. Hep. 1844.
Lichens	5,600	See Krempelhuber Gesch. Lich. 1870.
Fungi	11,890	See Strienz Nom. Fung. 1862.
Algae	6,200	See Kutzing Spec. Alg. 1849.
Total		131,104

But this number (131,104) is greatly increased by recent and vigorous contributions made especially in the vast field of the Cryptogamia in consequence of the improvements made in the microscope and the increased number of observers. In fact, according to Underwood, the American hepaticologist (cfr. Bot. Gaz. 1892) from 1844 to the present time the number of Liverworts by researches made in more regions of the world has doubled. And as for the Algae according to my learned colleague, G. B. De Toni, upon documents collected by him and in part published in his admirable *Sylloge Algarum*, the number of species described up to to-day is distributed as follows:

NO. SPEC.

Chlorophyceae	2,798 (Syll. Algar. Vol. I, 1889.)
Cyanophyceae	800 about.
Phaeophyceae	1,100 “
Florideae	2,100 “
Bacillariaceae (Diat.)	5,000 (Syll. Algar. Vol. II et seq.)
Characeae	200
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Total	12,178

Whence it appears that this vast group, too, has doubled since 1849.

Then in regard to the Fungi the results obtained in the active and multiplied researches of the last twenty years have surpassed all expectation. The number of species, in fact, reported in Vol. X of my *Sylloge Fungorum* and which goes to May of the current year, 1892, attains the marvellous sum of 39,663, that is to say, that in thirty years the group of Fungi has almost quadrupled.

We should therefore join to

Sum Total	131,104 (above indicated)
For the Liverworts	1,400
For the Fungi	27,773
For the Algae	5,978

and we have

166,255

This sum is deduced from positive data and it is annoying that on the other vegetable groups there is no information summing up the latest additions. However, to judge from the most recent botanical periodicals, as the *Botan. Jahresbericht*, the *Botan. Centralblatt*, the *Monographiae Phanerogamarum*, etc., etc., one cannot deny that the Mosses¹ have doubled since 1851 and that the Phanerogams and Ferns have increased almost five per cent.²

Thus we shall have:

Sum total preceding	166,255
For the Phanerogams an increase of	5,011
For the Ferns	134
For the Mosses	2,306
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Total	173,706

Which sum, then, represents with great approximation the true number of species of plants known up to the present time, that is 105,231 Phanerogams and 68,475 Cryptogams thus distributed:

¹The celebrated bryologist Schimper in the preface to his *Synopsis Muscorum* 1860-1876, thought that the Mosses of the whole world, when known, would amount to more than 8,000 species.

²The publication of the new and great *Nomenclator Plantarum* is eagerly awaited, already in part printed at London by the munificence of Darwin. From this one will be able to state exactly the real increase of the Phanerogams in these last years.

	NO. SPEC.
Phanerogams	105,231
Ferns	2,819
Equis., Marsil., Lycopod.	565
Mosses	4,609
Liverworts	3,041
Lichens	5,600
Fungi	39,603
Algae	12,178
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Total	173,706

When we consider the many regions which still remain to explore or are imperfectly explored, it is beyond doubt that the number of plants will still increase very greatly. And one may be certain that it will be the number of the cellular Cryptogams which will receive the greater increase, as compared with the higher plants. In fact the perfections of the microscope which permit the convenient study of these most minute productions are, we may say, of yesterday, and the prodigious conquests of these last years, accomplished above all in the field of the Cryptogams are proof of this.

But the chief design that moved me to write this short note regards the probable number of Fungi to appear. From a few hundred forms which were known at the beginning of the century we have jumped, as has been seen, to about 12,000 species in 1862, and to-day we have nearly 40,000 of them. An astonishing progression, which is not explained solely by the increase of investigations, but reveals the enormous and scattered mass of fungous forms. It has been objected by several botanists that the specific autonomy of many Fungi is not founded on a secure basis and that many such species are rather to be considered as "forms of substratum", that is variations of the same species by reason of the different substratum or matrix in which they grow. I do not wish to deny that several admitted species may find themselves in this situation, but it is to be observed that in beings for the most part simple and microscopic the differential characters cannot be of great importance to our eyes, and hence it is necessary to go slowly before refusing them as good, as one must observe principally their constancy.

After all, on the subject of these suspected forms of substratum, this is a fact worthy of much consideration, that we very often see upon the identical living matrix several species of the same genus maintain themselves, most distinct, although related, as happens, e. g., in the

genera *Sphaerella*, *Diaporthe*, *Leptosphaeria*, *Pleospora*, *Phoma*, etc., etc. If the matrix had acted to modify the characters of Fungi, why should we find mingled together on the same branch, on the same leaf, two *Diaporthes*, two *Sphaerellas*, perfectly distinct? I am therefore convinced that a reduction of species will have without doubt to be made, but always with great caution, retaining also on this subject the just precept: *melius est distinguere quam confundere*.

In the number of the Fungi are comprised also the so-called imperfect forms (*Sphaeropsidae*, *Melanconieae*, *Hyphomyceteae*) which amount to about 10,000 species. These, in the judgment of some mycologists, ought to be excluded from the census of species; but this does not seem just, because, if for some few we know for certain that they form part of the metagenetic cycle of known perfect forms, it is more certain still that of the greatest part we know nothing positively of their metagenesis and are able to suspect that they are permanent forms of which the perfect state either has disappeared, or is wanting or is very rare. Why then should we exclude from the census of fungi beings distinct and constant?

We have seen that in only thirty years the number of fungi has increased by almost 28,000 species. I may add that an increase of certainly 8,100 species belongs to the brief period from 1882 to 1890 (cfr. *Suppl. Syl. Fung.*) in spite of the fact that my *Sylloge Fungorum* was published contemporaneously, a repertorium of all the Fungi hitherto described. Now we ask ourselves: to what results will the already well-begun mycological researches lead us when we have extended them to the whole world and to all fungus-bearing hosts? Some example can perhaps enlighten us a little on this journey still to be made. One of the best known regions (although not perfectly) in respect to the Phanerogamic flora more than the Cryptogamic, is without doubt the Venetian region. In this, according to the enumeration made by the well known Professor De Visiani in his work of 1869 (*Catalogo delle piante vascolari del veneto*) we have 2939 Phanerogams, a number which even to-day remains almost unchanged. For the Cryptogams we have the accurate work of the G. Bizzozero published in 1885 (*Flora Veneta Crittogamica*, Ven. 1885), where the Venetian Cryptogams amount in all to about 6,000 of which 4,200 are fungi, a number raised now to about 4,800 by the researches of Professors A. N. Berlese, C. Massalongo, etc.

If the number of Venetian Phanerogams studied diligently from more than a century ago till our own time could not with new studies increase more than a very small number of species, it is positive that

the number of fungi will increase considerably. In fact the Venetian Hymenomycetes were until now scarcely studied and the interior provinces like those of Venezia, Rovigo, Vicenza, Belluno, Udine, which comprise the Alpine region which will give us without doubt a large contribution of new forms, are in a mycological respect almost entirely unexplored. I am therefore convinced that when all the Venetian territory is well explored, we will have at least 7,000 fungi in its Flora, a number which compared to that of the Phanerogams (2,939) surpasses it by certainly $\frac{3}{4}$. According to this proportion if we have to-day more than 105,000 Phanerogams in all the world, the fungi in order to exceed them by $\frac{3}{4}$ ought to ascend to about 245,000. This calculation cannot be accused of exaggeration when we see that the greatest part of the fungi being parasites, a connection between them and the hosts (for the most part Phanerogams) must necessarily exist.

But this is not all. We have rich and accurate repertoria of fungi according to their hosts; as the general one of Westendorp, the one for Venice of Cuboni and Mancini; the very recent one for North America of Farlow and Seymour. A glance at these repertoria shows us at once that there are very many Phanerogams which harbor parasitic fungi by tens and hundreds many of which are exclusive to them. We have moreover careful monographs of the fungi which grow upon the vine (Pirotta, Thuemen), on the Lemon and Orange (Penzig), on the Mulberry (Berlese). Now the fungi which grow upon the vine are according to the last census of Thuemen (1892) in number 595, those on the lemon and orange 190, those on the mulberry 200. When we consider these hosts as generic groups (*Vitis*, *Citrus*, *Morus*) and calculate that for each of these groups alone, on an average, 40 per cent. of the parasitic fungi are exclusive to them (and not wandering or pantogenous) we have: for the genus

<i>Vitis</i> , proper species of fungi	238
<i>Citrus</i>	76
<i>Morus</i>	80

the average of which numbers is 131. Now the genera of greater plants of Phanerogams being, according to Bentham and Hooker 8,417, if we reckon 131 fungi proper for each one of these genera, there results the huge cypher of 1,102,627 parasitic fungi, to which must be added that of terrestrial and non-parasitic (about 11,000) in all 1,113,627. Certainly this number does not appear at all impossible when we think that the data are taken from genera (*Vitis*, *Citrus*, *Morus*) which contains few species in comparison with others (e. g. *Solanum*, *Astragalus*, *Euphorbia*) which possess several hundred more of them, which with-

out any doubt have peculiar fungi. Nevertheless reflecting that several species or groups of plants are notoriously attacked by a less number of fungi; that in certain regions of the globe, whether because of dryness, or because of the scarce vegetation parasitic fungi are also rare;³ finally that woody natures, as the three taken for data, are habitually more attacked by parasitic fungi than the herbaceous, I believe I shall be held just and in every way conservative in calculating only thirty parasitic fungi, on the average, for each genus of Phanerogams. We have thus 252,510 species of parasitic fungi, which united to the recorded non-parasitic amount to a total of 263,510. The number of parasites (252,510) divided among all the known species of Phanerogams (105,000) would give us the reasonable number of a little more than two special fungi for each phanerogamic host, without counting that also the ferns, mosses, liverworts, and even the greater fungi, offer an asylum to not a few fungous parasites.

This calculation deduced from the number of fungi for each generic group of Phanerogams accords more than sufficiently with the calculation previously made from the connection of the number of species of Phanerogams and that of fungi in a given area well explored, in a way that makes it appear that the total number of species of fungi, perfect and imperfect, in the whole world ought to ascend at least to the neighborhood of 250,000, that is to say, a little more than six times the number we know to-day.

To summarize, we may conclude that the species of plants known and described up to the present time are about 174,000, divided into 105,000 Phanerogams and 69,000 Cryptogams, that is in the lump 50,000 more than were admitted even in recent works. As regards, then, the entire number of species which cloak our globe, by the calculations alone which I have previously explained regarding the fungous vegetation, I think we shall not go astray in estimating that the Flora of the world when it is completely enough known, will consist of at least 385,000 species of plants (that is, 250,000 fungi and 135,000 species of the other groups). If one wish only to reduce to 15,000 the species which will appear in these other groups (not fungi) the sum total of plants would ascend to 400,000 species at least.

³ Mycologic geography and statistics are still little advanced. However if we see Europe almost in every part rich in fungi, if we see Argentina and Brazil, Cuba and the United States, Australia and New Zealand, Siberia, Ceylon, and Algiers varyingly but yet always rich in fungi, this signifies that they are liberally diffused at least over a great part of the world.

When shall we come to know well this enormous number of plants? If since 1824 the sum of plants has jumped from 70,000 according to Steudel, to the modern sum of 174,000, that is in 68 years we have discovered 104,000 species, to arrive at a problematical 400,000 about 150 more years of research ought to run. Our remote grandchildren will see whether these prophecies are verified, or whether in this we are greatly in error.—P. A. SACCARDO. [In Atti Cong. Bot. Int. 1892. Translated by Roscoe Pound.]

New Book on Ferns.—A book on the “Study of the Biology of Ferns by the Collodion Method,” by Professor G. F. Atkinson of Cornell University is announced for early publication. It is to be fully illustrated from original drawings by the author, and will include in the descriptive portion a discussion of the development, morphology and anatomy of the gametophytic and sporophytic phases, while a second part deals with methods of study. The house of Macmillan & Co. is to bring out the book, which will be looked for with interest by laboratory botanists.—CHARLES E. BESSEY.